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Values, Policy, and Ecosystem Health

Robert T. Lackey[1]

Introduction

Ecosystem health is advocated widely as a useful, perhaps essential, concept in ecological policy. The concept enjoys an extensive following, especially in the popular media and with advocacy groups (Scrimgeour and Wicklum 1996, Gaudet et al. 1997).

Part of its appeal is that it appears to be a simple, straightforward, intuitive metaphor (Ryder 1990, De Leo and Levin 1997). Applying the notion of human health to ecosystems provides a paradigm for viewing ecological policy questions. By implication, adopting the metaphor also defines what types of scientific information are necessary to help decision makers (Norton 1995, Meyer 1997, Shrader-Frechette 1997, Lackey 1998). Adopting ecosystem health as a public policy goal, however, could have major, although usually unclear, ramifications:

> *". . . an ecosystem health focus sets the stage for a new environmental ethic — one in which actions may be judged by their contribution to maintaining or enhancing the health of the regional ecosystem."*
> (Rapport 1998)

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[1]*Robert T. Lackey (email: lackey.robert@epa.gov) is a natural resource ecologist at the National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Corvallis, Oregon 97333. He is also courtesy professor of fisheries science and adjunct professor of political science at Oregon State University. The views and opinions expressed do not necessarily reflect those of any organization.*

> *" . . . enhancing ecosystem health represents a goal with critical importance to our future. Without ecosystem health, the very foundations of our social and economic systems are undermined."* (Rapport 1998)

> *"The articulation of ecosystem health goals and indicators of performance to achieve these goals is a necessity if the future for humankind is to be viable."* (Rapport 1998)

If Rapport (and many others) are correct, the implications to individuals and society of implementing ecosystem health as a cornerstone of public policy would be considerable, perhaps even revolutionary.

The purposes of this article are to evaluate the notions of ecosystem health and describe the policy implications of adopting ecosystem health as a goal in ecological policy. Throughout the article, I have attempted to be policy *relevant* without being a policy *advocate*.

To most proponents of *ecosystem* health, the alluring feature of the *human* health metaphor is that people have an inherent understanding of personal health (Ryder 1990). By extension most people envision instinctively a "healthy" ecosystem (e.g., a forest, lake, or pastoral landscape) as being pristine or at least appearing to be minimally altered by human action. Thus, it is argued, ecosystem health is intuitively grasped by the general public, policy officials, and scientists (Meyer 1997).

Most concepts of human health focus on the *individual* human, whereas ecosystem health treats the *ecosystem* as the unit of policy concern, not the individual animal or plant (Schaeffer et al. 1988)(Figure 1). Concerns about *individual* animals or plants — the typical focus of "animal rights" and "animal welfare" policy — are not typically the level at which *ecological* policy is debated.

There is no universal conception of ecosystem health, thus there is considerable variation in the doctrine or concept being described or defined (Calow 1992, De Leo and Levin 1997). Karr and Chu (1999), for example, reflect a common, but not universal, position that concepts of ecosystem *health* and *integrity*, although related, are fundamentally different. They define ecosystem *health* as the *preferred* state of ecosystems modified by human activity (e.g., farm land, urban environments, airports, managed forests). In contrast, ecological *integrity* is defined as an *unimpaired* condition in which ecosystems show little or no influence from human actions. Ecosystems with a high degree of integrity are natural, pristine, and often labeled as the base line or benchmark condition. *Natural* ecosystems, by definition,

would continue to function in essentially the same way if humans were removed (Anderson 1991).

Others make no such distinction and may even describe ecosystem health and integrity as different words for the same general concept. Regier (1993), for example, concludes that

> *" . . . the notion of ecosystem integrity is rooted in certain ecological concepts combined with certain sets of human values"*

and, thus, a desired ecosystem condition

> *". . . other than the pristine or naturally whole may be taken to be 'good and normal.'"*

Hence, according to Regier and many others, if one accepts that there are multiple (and equally acceptable) benchmarks for ecosystems with integrity, then the terms ecosystem health and ecosystem integrity would be conceptually the same. However, for the remainder of this article, I will use the definitions of ecosystem health and ecosystem integrity used by Karr and Chu (1999) where the two notions represent different, but related, intellectual constructs.

The majority of ecological policy debates concern ecosystem "health" rather than ecosystem "integrity" (Westra 1998). Such an emphasis on health (ecosystems altered by humans) is understandable because the vast majority of ecosystems are not pristine or even close to pristine; hence, according to the definitions used here, altered ecosystems lack at least some integrity (Figure 2). Westra (1998) clearly describes the relationship between the two concepts:

> *". . . an ecosystem can be said to possess integrity when it is wild — that is, free as much as possible from human intervention today, and 'unmanaged,' although not necessarily pristine. This aspect of integrity is the most significant one; it is the aspect that differentiates the wild from ecosystem health, which allows support and manipulation."*

Points of controversy

Ecosystem health, especially in the 1970s and 1980s, was defined in nebulous terms — definitely not as a clearly articulated policy-making construct (Steedman 1994). It was typically depicted as a broad societal aspiration rather than a precise policy goal or management target (Rapport 1995). Lacking precise definition, it was difficult to consider the concept as a practical public policy goal. As the concept

emerged from semantic ambiguity with more precise definition and description, it became a serious topic for discussion and, predictably, a lightning rod for conflict (Wicklum and Davies 1995, Meyer 1997).

The concept and implementation of ecosystem health continue to be surrounded by controversy (Jamieson 1995, Wicklum and Davies 1995, Callicott 1995, Belaoussoff and Kevan 1998). Addressing questions of ecosystem health might appear to be a fairly scholarly, perhaps even arcane, activity, free from the policy intrigue that dominates much of the science and policy underlying environmental and natural resource management, but such is not the case. Concepts of ecosystem health are seldom afforded the luxury of dispassionate discussion because, as Wicklum and Davies (1995) observe:

> *"The phrases ecosystem health and ecosystem integrity are not simply subtle semantic variations on the accepted connotations of the words health and integrity. Health and integrity are not inherent properties of ecosystems."*

Wicklum and Davies (1995) realize that the word "health" elicits powerful, positive images even if its meaning is variable and ambiguous. Therefore, they argue, a precise understanding of ecosystem health is essential because it is likely to be used, and given a variety of meanings, by scientists, policy advocates, politicians, bureaucrats, and the general public. In practice, it may fall to scientists and other technocrats to provide operational clarity to the perplexing, value-laden notion of ecosystem health that appeal on an intuitive level to nearly everyone (Meyer 1997). In reality, value-based ecological concepts, such as ecosystem health, become general perceptions, perhaps useful in general conversation, but impossible to quantify (Ryder 1990).

Ecosystem health and related concepts have become highly charged political terms (Jamieson 1995), often to the extent that they have become shorthand descriptors for one faction in political debates. Even in the relatively isolated venues of academic and government laboratories, an assertion that ecosystem health is not a scientifically sound concept may be sufficient to have the perpetrator branded as a political reactionary. Conversely, a scientist embracing the notion of ecosystem health may be dismissed by fellow scientists as a political zealot who is using his scientific credentials to champion a personal policy preference. Callicott et al. (1999) characterizes debates over the merits of ecosystem health and similar concepts as those where ". . . partisans of a single normative concept try to make it cannibalize or vanquish all the rest."

Thoughtful discussions about ecosystem health and similar concepts are usually abstract, often contentious, and rarely lead to consensus, but is the use of the health metaphor, even as a heuristic tool, ill-advised? Shrader-Frechette (1997) counseled

against using the concept of ecosystem health to communicate to the public about environmental issues because the concept does not add new information to policy debates, nor does it explain policy tradeoffs. Kapustka and Landis (1998) exhort against the metaphor because it is misleading and based on the chosen values and judgments, not an *independent* scientific reality. Conversely, Callicott (1995) concludes that ecosystem health is intellectually defensible and heuristically valuable, but he concedes that the *value*, thus the calibration, of ecosystem health is subjective. Indeed, Callicott et al. (1999) classify it as an "ill-defined normative concept" that reflects the "occurrence of normal ecosystem processes and functions." Few proponents explain in specific terms the *implications* for individuals and society of implementing the concept.

Regardless of the merit and direction of the scholarly debate, notions of ecosystem health frame important public policy issues (*i.e.*, sustainability of agriculture, overuse of marine resources, scarcity of water for domestic and agricultural use, and ecological consequences of introduced species). Ecological policy issues are not mere abstract intellectual concerns, but matters that affect people's daily lives (Shrader-Frechette 1997).

Normative science

At the core of the debate over ecosystem health are a number of implicit, but highly contested, value-based assumptions that masquerade as science. Such value-based assumptions imply a policy preference. Such "science" is often dubbed *normative* science. Science becomes normative when results are interpreted through the filter of an assumption that defines an inherent policy preference (Lackey 1999). Many examples of normative science are obvious: others are subtle.

An example of the use of normative science in ecosystem health concerns the long-debated assumption and assertion that ecosystems are "real" (Calow 1992, Callicott 1995). Kapustka and Landis (1998) assert that "no human has ever seen an ecosystem" because it is not a discrete unit like individual birds, trees, or worms, or even populations of organisms. However, when a science or policy problem is specified (*i.e.*, a "salmon" issue), then the ecological boundaries (*i.e.*, the *ecosystem)* follow intuitively. Thus, ecosystems are context-specific because they cannot be delimited without a science or policy concern or issue and, therefore, may have heuristic and problem-solving value, but are not analogous to the patient in medicine (Suter 1993).

Although rarely stated clearly, in most formulations of ecosystem health, there is a premise that *natural* systems are healthier than human-altered systems (Wicklum

and Davies 1995) (Figure 3). For example, consider a defined geographic location and given the alternatives of a pristine woodland, a housing subdivision, or an industrial complex, which is the healthiest? The subdivision may be necessary, even somewhat aesthetically pleasing, and the industrial complex may serve a worthy purpose, but almost everyone indubitably considers the "unaltered" woodland to be the *healthiest*. Tacitly, the assumption is that pristine, or less altered, is good and preferred; highly altered ecosystems, in contrast, are less desirable, if not "degraded." Thus, recognizing the normative basis for ecosystem health, Fairbrother (1998) concludes: ". . . use of the term 'ecosystem health' as a definition of an idealized state is not an appropriate paradigm."

Another common assumption involves the importance of biological diversity to *society*. Biological diversity is certainly an important element in understanding the structure and function of ecosystems, but the key policy assumption revolves around the level of importance *society* has for biological diversity or its constituent elements. For example, some argue that biological diversity is such a core (i.e., societal) policy value that scientists should actively lobby for it. As Meffe and Viederman (1995) bluntly recommend:

> *"Scientists can take a clear stand that biodiversity is good, that functioning and intact ecosystems are good, that continued evolutionary change and adaptation are good, and that diversity and variation in general is good. Scientists cannot and should not remove themselves from these usually unstated value judgments."*

Meffe and Viederman (1995) encourage scientists to drop the facade of political neutrality and lobby for those policy choices that *they* deem to be in the best interests of society.

Invariably, concepts of ecosystem health implicitly assume that certain ecosystem features such as biological diversity have an *inherent* policy importance (Schaeffer et al. 1988). Ecosystems are complex, typically in both structure and function, and the diversity of species within an ecosystem is important to determining how that particular ecosystem functions, but biological diversity is *inherently* no more important to ecosystems than is nutrient cycling, carbon storage, or the rate of photosynthesis. As a public policy priority, and apart from its ecological function, society collectively may ascribe high (or low) value to preservation of certain, perhaps all, species, based on *human* values and preferences (Lackey 1998).

Although not universally assumed, a common tacit assumption is that there is a "natural" ecosystem state (*i.e.*, balance of nature) akin to the simple homoeostatic dynamics of physiological systems (Anderson 1991, Belovsky 1999). The existence of such a natural state is appealing because disruption of an ecosystems's balance —

deviation from its natural state — can be used to define and measure "health." Unfortunately, this idealized view of ecosystems does not typically exist. Ecosystems may not predictably approach single-point equilibrium, but may oscillate over time in a fairly indeterminate manner (Belovsky 1999).

Societal Values

Few challenge the assertion that societal preferences should drive the environmental management goals inherent in implementing ecosystem health, but the question remains how and which societal aspirations will be selected (Gaudet et al. 1997, Meyer 1997). Society is not a monolith; there are many competing opinions of the relative importance of what should be preeminent societal aspirations or preferences. The market place, the most common approach to adjudicating competing societal preferences, is never totally unconstrained, nor do most participants have much understanding of the long-term ecological consequences of their individual market decisions. Thus, economics has an important role in helping understand and resolve competing societal preferences, but most conclude that it is insufficient in itself.

The language and discussion of ecosystem health is value laden (Jamieson 1995), but how are societal values and preferences to be incorporated when using ecosystem health in public policy? The crux of the policy challenge is deciding which of the diverse set of societal preferences are to be adopted. Resolving policy issues always consists of tradeoffs, partially or entirely exclusive alternatives, winners and losers, and plenty of compromises.

Consider any specific ecological policy issue: who are the stakeholders and how should their conflicting input be used to define ecosystem health? The task is *relatively* easy when policy problems are defined narrowly, such as licensing a particular chemical or authorizing a timber harvest rate for an individual forest. The task is more difficult for achieving broad societal aspirations such as ecosystem health. For example, who are the stakeholders for deciding policy on "national" forests? Are they local, regional, national, some weighted combination, or all citizens equally? Obviously local residents are most directly affected by policy decisions about national forests, but the forest is "owned" by everyone, thus, urban voters several time zones away may have the controlling political power. For example, defining stakeholders as those most directly affected would result in national forests being managed primarily for the benefit of adjacent residents. Conversely, defining stakeholders as all members of society, would likely result in different policy priorities.

What role should science and scientists play in defining ecosystem health? Scientific information is important, even essential, but it is only part of what is needed (Gaudet et al. 1997). Most important ecological policy issues involve coarse scales. Unfortunately, most scientific information is of a fine scale and narrowly focused, thus only indirectly relevant to many ecological policy questions. Further, political institutions (legislative and regulatory agencies) must balance competing values and preferences, so scientific information is merely one facet of decision making. For the political process of adjudicating conflicts over value and preferences, science offers no moral or ethical guidance (Kapustka and Landis 1998).

An argument is sometimes advanced that, because ecosystem health shrouds difficult and painful tradeoffs under the guise of science, its use actually inhibits incorporation of societal values and preferences by not forcing an explicit selection from competing policy options. As Suter (1993) observes in evaluating various attempts to implement ecosystem health:

> *"Use of unreal properties (particularly unreal properties with imposing names) in environmental regulation obscures the bases for decision making; increases the opportunity for arbitrariness; and decreases the opportunity for informed input by the public, regulated parties, or advocacy groups."*

Shrader-Frechette (1997) asserts that the concept of ecosystem health does little, in spite of grand rhetoric, to improve decision making because proponents have failed to:

> *". . . clarify the precise respects in which the term yields additional scientific explanation beyond those provided by assessments of production, biodiversity, and so on."*

Conversely, Meyer (1997) concludes that the value of ecosystem health is that it ". . . offers a view of nature that is useful for an audience of managers, policy makers, and taxpayers."

Misuse of ecosystem health

The most pervasive misuse of ecosystem health and similar normative notions is insertion of personal values under the guise of "scientific" impartiality. Most concepts of ecosystem health require a benchmark (i.e., a *desired, preferred,* or *reference* condition) of an ecosystem. Often, the implicit assumption (benchmark) is that an "undisturbed" or "natural" ecosystem is superior, thus preferred, to an "altered" one (Anderson 1991). An ecosystem, altered by human influences, is obviously different than the previous state, but there is nothing *scientific* that

compels *any* specific ecological state to be considered preferred or better (more healthy) and, thus, *the* benchmark. Lele and Norgaard (1996) caution those searching for scientifically derived benchmarks for ecosystems: "Naturalness as the benchmark is neither value-free nor logically or practically useable."

Practical expressions of ecosystem health reflect values and preferences (Gaudet et al. 1997). A misuse of the concept is the situation in which professionals, usually operating from bureaucratic positions, *de facto* determine healthy (i.e., preferred) target ecosystems conditions. Ecosystem health is normative because someone must decide what ecosystem condition or function is "good" (Sagoff 1995). Ecosystems have no preferences about their states, thus preferred states or *benchmarks* must come from the individuals doing the evaluation (Jamieson 1995). One common approach is to arbitrarily select reference sites to serve as the benchmarks (e.g., the best attainable or healthiest condition) for the ecosystems in question, but Kapustka and Landis (1998) conclude that the principal danger for scientists attempting to define "healthy" ecosystems comes from the incorporation of beliefs, morals, values, and ethics as *properties* of ecological systems.

Another, less obvious, but disconcerting, use of the concept of ecosystem health is defining a public policy goal in vague terms that engender broad political support, labeling it ecosystem health, but camouflaging the ramifications of its adoption. Indeed, there *is* general public support for the idea of maintaining ecosystem health, but few grasp the consequences of such a policy approach, including the possible implications on democratic processes or the autonomy of nation-states. Westra (1996), for example, candidly stated some far reaching political consequences:

> *". . . no country's unilateral decision, no matter how representative it might be of its citizens' values, should be permitted to prevail, unless it does not conflict with the global requirements of the ethics of integrity, thus with true sustainability."*

A deceptive, but often effective, use of the concept of ecosystem health is pejoratively categorizing opposing policy choices. After all, the competing policy choices must, by definition, not be appropriate for achieving ecosystem health. One policy choice then becomes identified as promoting "health" with the alternatives struggling to avoid being dismissed as arguing for "sickness." For example, a policy decision to drain a wetland to create a corn field might legitimately be categorized as appropriate to maintain ecosystem health. Either the wetland or corn field could be healthy, depending on the societal preferences embraced. Because "health" conveys a positive political connotation, the common practice in policy debates is to capture the high ground by labeling *your* policy choices as being necessary for health and those of your opponents as leading to sickness or ecosystem degradation.

Environmental managers are culpable, often unintentionally, of misusing the concept of ecosystem health. Understandably, those responsible for making difficult, controversial policy decisions may be reluctant to define their goals clearly, so they sometimes embrace ecosystem health in the mistaken belief that it is a scientifically operational term. After evaluating the potential uses of the health metaphor in environmental management, Suter (1993) concludes:

> *". . . environmental managers are active agents, translating the inchoate norms of the current generation and the poorly predicted needs of future generations into specific actions to protect or restore real, valued properties of actual ecosystems. . . . Hence, the decision to abandon ecosystem health as a goal is not just a matter of semantics."*

Kapustka and Landis (1998) admonish against using normative concepts such as ecosystem health:

> *"If we are to manage the environment, it should be done with the clear knowledge that choices will have to be made, not fueled by misplaced desires or myths."*

Alternatives

Ecological policy issues such as managing the consequences of human land use, reduced biological diversity, or the cumulative effects of chemical use, are real and demand serious attention by society (Science Advisory Board 1999). Concepts based on normative science can be compelling, but even many proponents concede that there are serious conceptual or operational difficulties with such concepts. Whether the intuitive communicative and heuristic value of the phrase ecosystem health ". . . outweighs its clearly invalid theoretical implications remains to be seen." (Scrimgeour and Wicklum 1996) But what, if any, are the alternatives?

The most direct alternative to using normative science is to cease using words such as ecosystem health and simply and clearly describe what is proposed. More specifically, rather than propose a policy objective of managing a forest for "health," express exactly and clearly the public policy and management objective.

A second alternative to using ecosystem health is to treat ecological policy issues as yet another complex public policy question and not to rely on any metaphor. Other policy issues (e.g., welfare, education, energy, transportation) are also complex and challenging, but overarching, explicit heuristic models or metaphors are not typically used except in political discourse.

If a notion of ecosystem health is to be used in implementing ecological policy, then coherent, clear, quantifiable definitions should be used (Ulanowicz 1997).

Currently there are many, often contradictory, definitions of ecosystem health, so consensus on the exact meaning is essential to focusing policy debate on societal tradeoffs, not semantic niceties.

Regardless of whether normative concepts are used in ecological policy deliberations, public involvement (even as fractured as the public often appears to be) is essential because it is *values* that drive policy. Public involvement should be at the essence of using normative concepts because of their requirement for *inherent* value judgments. As Rykiel (1998) explains:

> *"In a simplistic sense, science deals with true and false, whereas society deals with good and bad. Science can delineate the possibilities and describe the system that is likely to result from a policy, but it cannot decide if the resulting system is good or bad."*

Thus, policy *decisions* are, by definition, normative because values and preferences were used by the decision maker to select a particular option.

Future direction

"Ecology" has become much more than a scholarly discipline; it has impacts far beyond simply enhancing our understanding of ecosystems. Many uses of "ecology" (including ecosystem health) have a strong normative and typically politically "green" flavor. As Worster (1990) observes:

> *"The science of ecology has had a popular impact unlike that of any other academic field of research. Consider the extraordinary ubiquity of the word itself: it has appeared in the most everyday places and the most astonishing, on day-glo T-shirts, in corporate advertising, and on bridge abutments. It has changed the language of politics and philosophy — springing up in a number of countries are political groups that are self-identified as 'Ecology Parties.'"*

The future role of normative science, generally, and ecosystem health, particularly, is uncertain. At the ideological extreme, there are stark opinions. Some argue that using normative science in constructs such as ecosystem health is desirable, even essential, for implementing ecological policy. Scientists, they assert, have an obligation to incorporate *policy* value judgments into ecology, even to the point that such "science" concepts as ecosystem health should be adopted as the cornerstone of ecological policy (Callicott 1995). Some scientific disciplines and professions (e.g., conservation biology, restoration ecology) unapologetically embrace normative science postulates as the core of their trade (e.g., biological diversity is inherently good, extinction of populations and species is inherently bad, ecological complexity is inherently good, evolution is good, biological diversity has intrinsic

value) (Soule 1985).

Others, however, assert that normatively-based concepts, such as ecosystem health, hide behind a veneer of science the reality of necessary and difficult policy choices involving competing, often divisive, societal values (Kapustka and Landis 1998). In short, it is not the role of science to hide fractious choices that society should appropriately decide, but to help lay out options and assess the consequences of various choices (Meyer 1997).

Scientists and scientific information will continue to play an important role in resolving ecological policy, but the role, in my opinion, should be carefully circumscribed (Lackey 1998, 1999). Often, even within the community of scientists, "ecology" has been treated more as a belief system than a science (Figure 4). It is easy, even encouraged, for scientists to abuse privileged roles in ecological policy debates by surreptitiously labeling personal values and policy preferences as "science" (Salzman 1995).

Understanding the values and preferences of society is crucial to *appropriately* implement concepts of ecosystem health, but obtaining such understanding credibly is difficult. To assert, however, that concepts of ecosystem health are merely scientific constructs is incorrect. As Russow (1995) concludes, ". . . the claim that scientific descriptions in general or measures of ecosystem health in particular are value neutral is simply false." The likely alternative to public involvement is that the values of scientists and other technocrats will be used as surrogates for societal values and preferences.

The ecological policy concerns that engender widespread debate over ecosystem health and other normative constructs will not disappear. These concerns need to be addressed because of the increasing demand on limited ecological resources (Salwasser et al. 1997). The resolution of ecological policy is likely to become increasingly challenging because interactions among the planet, the non-human occupants, and the large, yet expanding, human population, constitute a dynamic system of rapidly increasingly complexity (National Research Council 1997). Whether or not one finds intellectual sustenance in the notion of ecosystem health, the policy concerns its proponents attempt to confront are genuine.

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Biographic sketch

Dr. Robert T. Lackey is a natural resource ecologist with the U.S. Environmental Protection Agency's research laboratory in Corvallis, Oregon. He is also courtesy professor of fisheries science and adjunct professor of political science at Oregon State University, where he teaches a graduate course in ecological policy. For the past 35 years he has dealt with a range of environmental issues from positions in government and academia. Among his professional interests are natural resource ecology, ecosystem management, and the interface between science and public policy. His research have resulted in 85 journal articles and a book on fisheries science, as well as editing three others. He has also taught natural resource and environmental science courses at five North American universities.